


Form PTO-1390U S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE (REV 10-95) TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		ATTORNEY'S DOCKET NUMBER 2204-002012
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INTERNATIONAL APPLICATION NO PCT/JP99/05727	INTERNATIONAL FILING DATE 18.10.99 (October 18, 1999)	PRIORITY DATES CLAIMED 19.10.98 (October 19, 1998) 06.07.99 (July 6, 1999)
TITLE OF INVENTION ALUMINUM-PLATED STEEL SHEET FOR FUEL TANK AND PROCESS FOR PRODUCING FUEL TANK FROM THE STEEL SHEET		
APPLICANT(S) FOR DO/EO/US Hirofumi TAKETSU, Masaya YAMAMOTO, Keiji IZUMI and Shuntaro SUDO		
<p>Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:</p> <ol style="list-style-type: none"> <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1). <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)) <ol style="list-style-type: none"> <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau). <input checked="" type="checkbox"/> has been transmitted by the International Bureau. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US) <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)). <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)) <ol style="list-style-type: none"> <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau). <input type="checkbox"/> have been transmitted by the International Bureau. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired <input checked="" type="checkbox"/> have not been made and will not be made <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)) <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)) <p>Items 11. to 16. below concern document(s) or information included:</p> <ol style="list-style-type: none"> <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98 <input checked="" type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included <input checked="" type="checkbox"/> A FIRST preliminary amendment. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment. <input type="checkbox"/> A substitute specification. <input type="checkbox"/> A change of power of attorney and/or address letter. <input checked="" type="checkbox"/> Other items or information: <ol style="list-style-type: none"> WO 00/23336-Front Page with Abstract and Search Report (4 pp.) International Preliminary Examination Report (translation) (3 pp.) 		

U.S. APPLICATION NO. 09/787998	INTERNATIONAL APPLICATION NO. PCT/JP99/05727	ATTORNEY'S DOCKET NUMBER 2204-002012
17 <input checked="" type="checkbox"/> The following fees are submitted. BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EPO or JPO... \$860.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) \$690.00 No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2))..... \$710.00 Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO..... \$1000.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4)..... \$100.00		CALCULATIONS PTO USE ONLY
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CLAIMS	NUMBER FILED	NUMBER EXTRA
Total claims	10 - 20	0
Independent claims	2 - 3 =	0
MULTIPLE DEPENDENT CLAIM(S) (if applicable)		+ \$270.00
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NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.		
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PATENT APPLICATION/PCT
Atty. Docket No. 2204-002012

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

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ALUMINUM-PLATED STEEL
SHEET FOR FUEL TANK AND
PROCESS FOR PRODUCING
FUEL TANK FROM THE STEEL
SHEET

International Application
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Pittsburgh Pennsylvania
March 23, 2001

PRELIMINARY MENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to initial examination, please amend the above-identified patent application as follows:

IN THE SPECIFICATION:

Please delete and amend section headings as follows. (Pursuant to 37 CFR

1.121, marked-up versions of the amended section headings are attached.)

On page 1, please delete the section heading "SPECIFICATION".

On page 1, please amend the section heading "TECHNICAL FIELD OF THE INVENTION" to read as follows:

BACKGROUND OF THE INVENTION

1. Field of the Invention

On page 1, please amend the section heading "BACKGROUND OF THE INVENTION" to read as follows:

2. Prior Art

On page 4, please amend the section heading "DISCLOSURE OF THE INVENTION" to read as follows:

SUMMARY OF THE INVENTION

On page 5, please amend the section heading "EMBODIMENTS OF THE INVENTION" to read as follows:

DESCRIPTION OF THE PREFERRED EMBODIMENTS

IN THE CLAIMS:

Please cancel the previous versions of claims 5-8 and insert the amended versions of claims 5-8 as follows. (Pursuant to 37 CFR 1.121, marked-up versions of these claims are attached.)

5. (Amended) The Al-coated steel sheet for a fuel tank defined in Claim 3, wherein the alkali-soluble resin is urethane.

6. (Amended) The Al-coated steel sheet for a fuel tank defined in Claim 1, wherein the resin film is mixed with 1-25mass% a powdery synthetic resin.

7. (Amended) The Al-coated steel sheet for a fuel tank defined in Claim 1, wherein the resin film has a thickness of 0.2-5.0 μ m.

8. (Amended) A method of manufacturing a fuel tank comprising the steps of:

preparing an Al-coated steel sheet on which an alkali-soluble resin film is directly formed,

press-working said Al-coated steel sheet to prepare upper and lower halves of a fuel tank,

washing said upper and lower halves with an alkali liquid to dissolve off said resin film,

welding said upper half to said lower half, and

applying a paint to an external surface of said upper and lower halves.

Please insert new claims 9 and 10 as follows.

9. The Al-coated steel sheet for a fuel tank defined in Claim 3, wherein the alkali-soluble resin is acrylic resin.

10. The Al-coated steel sheet for a fuel tank defined in Claim 1, wherein the resin film is mixed with 1-30mass% powdery silica.

REMARKS

The specification has been amended to place the application in conformance with standard United States patent practice.

Claims 5-8 have been amended to bring the claims into conformance with standard United States patent practice. New claims 9 and 10 have been added to further define the invention.

Examination and allowance of pending claims 1-10 are respectfully requested.

Respectfully submitted,

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MARKED-UP AMENDED SPECIFICATION PARAGRAPHS

Page 1, first section heading

[TECHNICAL FIELD OF THE INVENTION] BACKGROUND OF THE
INVENTION

1. Field of the Invention

Page 1, second section heading

[BACKGROUND OF THE INVENTION] 2. Prior Art

Page 4, section heading

[DISCLOSURE OF THE INVENTION] SUMMARY OF THE INVENTION

Page 5, second section heading

[EMOBDIMENTS OF THE INVENTION] DESCRIPTION OF THE PREFERRED
EMBODIMENTS

MARKED-UP AMENDED CLAIMS

5. (Amended) The Al-coated steel sheet for a fuel tank defined in Claim 3 [or 4], wherein the alkali-soluble resin is urethane [or acrylic resin].

6. (Amended) The Al-coated steel sheet for a fuel tank defined in Claim 1, wherein the resin film is mixed with 1-25mass% a powdery synthetic resin [and/or 1-30mass% powdery silica].

7. (Amended) The Al-coated steel sheet for a fuel tank defined in Claim 1, wherein the resin film has a thickness of 0.2-5.0 μ m [in thickness is formed on the Al-coated steel sheet].

8. (Amended) A method of manufacturing a fuel tank comprising the steps of:

preparing an Al-coated steel sheet on which an alkali-soluble resin film is directly formed,

press-working said Al-coated steel sheet to prepare upper and lower halves of a fuel tank,

washing said upper and lower halves with an alkali liquid to dissolve off said resin film,

welding said upper half to said lower half, and

applying a paint to an external surface of said upper and lower halves.

SPECIFICATION

AN AL-COATED STEEL SHEET FOR USE AS A FUEL TANK AND
A METHOD OF MANUFACTURING A FUEL TANK THEREFROM

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TECHNICAL FIELD OF THE INVENTION

The present invention relates to an Al-coated steel sheet excellent in anti-scratching property during press-working and corrosion-resistance to a stored fuel, and also relates to a method of manufacturing a fuel tank from the Al-coated steel sheet.

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BACKGROUND OF THE INVENTION

A fuel tank 1 for an automobile or the like has been conventionally manufactured by the following manner: An upper half 2 and a lower half 3 are independently prepared from steel sheets by press-working, and then washed with an alkali liquid. Halves 2 and 3 are assembled to a tank shape, joined together by resistance-welding such as seam-welding and spot-welding, and then coated with an anti-corrosion paint at their whole external surfaces, as shown in Fig. 2.

The upper half 2 and the lower half 3 have sinks 4 of the same openings and shapes. Flanges 5 are formed at the whole periphery of the sinks 4. These halves 2 and 3 are joined to a unitary body by putting the flange 5 of the upper half 2 on the flange 5 of the lower half and welding together. Since a material is worked to the fuel tank with heavy duty, it shall be good of press-workability, resistance-weldability and post-coat corrosion-resistance. In the state that such the fuel tank is installed in an automobile, its inner surface is exposed to a corrosive atmosphere containing a fuel. If the inner surface is corroded by the fuel, a filter of a fuel circulation system is

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choked up by resulting corrosion products. The corrosion sometimes causes generation of through holes. In this sense, the material shall be good of corrosion-resistance.

5 A steel sheet hot-dip coated with a Pb-Sn alloy (as disclosed in JP57-6133B) and a Zn-coated steel sheet (JP53-19981B) have been used so far, in order to satisfy such requisitions for a material of a fuel tank.

Although the steel sheet hot-dip coated with a Pb-Sn alloy exhibits excellent corrosion-resistance against a fuel solely composed of gasoline, it is likely corroded by alcohol in the case where a fuel tank receives an alcoholic
10 fuel such as methanol or ethanol or a fuel mixture of alcohol with gasoline. When a fuel tank made from the Zn-coated steel sheet is used for receiving degraded gasoline as a fuel or left in a humid environment at a high temperature over a long term, it is attacked by corrosive substances such as formic acid and acetic acid generated by oxidation and degradation of the
15 gasoline, resulting in generation of white rusts.

A steel sheet coated with Al or an Al-Si alloy (as disclosed in JP4-68399B) or an Al-coated steel sheet to which an organic resin film dispersing metal powder therein is applied (hereinafter referred to as "an anti-corrosion painted steel sheet", as disclosed in JP6-306637A, JP9-53166A) is proposed as
20 a material for a fuel tank in order to eliminate the above-mentioned problems. Corrosion-resistance of the Al-coated steel sheet against an organic acid is enhanced by protective function of an oxide film formed on a surface of the Al plating layer. The anti-corrosion painted steel sheet exhibits good corrosion-resistance against gasoline due to the organic resin film, and metal powder
25 dispersed in the organic film bestows the organic film with electric conductivity so as to facilitate resistance-welding the upper half 2 with the lower half 3.

However, an Al plating layer formed on the steel sheet is inferior of

anti-scratching property during press-working, so that substrate steel is often partially exposed to the outside when it is press-worked to upper and lower halves 2, 3. The exposed part will be an origin of internal corrosion, when it is subjected to degraded gasoline including organic acids. A paint film applied to the external surface of the fuel tank does not fulfill its corrosion-preventing function during progress of under-coat corrosion in some cases. On the other hand, the anti-corrosion painted steel sheet is often materially ruptured due to poor lubricity, when it is press-worked to members of a fuel tank.

The plastic reformation of the anti-corrosion painted steel sheet during press-working is improved by applying a lubricate film of an organic resin good of lubricity, anti-corrosion and plasticity to a surface of the anti-corrosion painted steel sheet (as disclosed JP6-306637A, JP9-53166A). However, when the anti-corrosion painted steel sheet after application of the lubricate film is worked to a shape of the fuel tank, the organic resin film as well as the lubricate film are thermally decomposed during resistance-welding. Offensive odor and smoke are abundantly generated by the decomposition, so as to deteriorate the working environment.

Application of an alkali-soluble lubricate film is also proposed, in order to facilitate removal of the lubricate film before welding the upper half 2 to the lower half 3. Although the alkali-soluble lubricate film can be washed off by an alkali, an organic resin film remains on a surface of the steel sheet and causes generation of offensive odor and smoke. Consequently, it is necessary to completely remove the organic resin film from the flanges 5 of the upper and lower halves 2, 3 before welding. Although the organic resin film is peeled off by a chemical method such as application of a proper peeling agent or a mechanical method such as polishing, anyway also needs time and labor.

Lubricity of a resin film may be improved by dispersion of a powdery synthetic resin such as polyolefin or fluororesin to an organic resin film

instead of an lubricate film. However, such the additive deteriorates adhesiveness and durability of a anti-corrosion paint film applied to the external surface of the fuel tank and causes exfoliation of the paint film during using.

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DISCLOSURE OF THE INVENTION

The present invention is accomplished for elimination of the above-mentioned problems. The object of the present invention is to offer an Al-coated steel sheet, which satisfies requisitions for use as a fuel tank superior
10 of corrosion-resistance and durability.

According to the present invention, an alkali-soluble resin film is directly applied to a surface of an Al-coated steel sheet. The Al-coated steel sheet, to which the alkali-soluble resin film is applied, is formed to upper and lower halves of a fuel tank by press-working. The upper and lower halves are
15 washed with an alkali liquid to dissolve off the resin film and joined together to a unitary body. Thereafter, a paint is applied to an external surface of the unitary body. A fuel tank excellent in corrosion-resistance and durability is manufactured in this way.

An alkali-soluble resin applied to a surface of an Al-coated steel sheet
20 is preferably one, which can be dissolved in an alkali liquid of pH 9.0 or higher, has a carboxyl group in its molecule with an acid value of 40-90. A resin having hydrogen atoms of the carboxyl group substituted by an alkali metal at a ratio of 1-50% is especially recommended, since it is dissolved off in 1 minute by an alkali liquid of pH 9.0. A urethane or acrylic resin excellent in
25 adhesiveness and plasticity is used as such a resin, to inhibit peeling of a resin film during press-working. Lubricity of the resin film can be also improved by dispersion of 1-25 mass % a powdery synthetic resin and/or 1-30 mass % powdery silica. The resin film is preferably of 0.2-5.0 μ m in thickness.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a graph showing effects of a pH value and a temperature of an alkali liquid on dissolution of a resin film. The resin film was of 1.0 μ m in thickness and formed on a surface of a steel sheet hot-dip coated with an Al-9%Si alloy at a ratio of 30g/m² per single surface by applying an emulsion of a urethane resin having a carboxyl group in its molecule with an acid value of 70 with a bar-type applicator and then baked in an oven.

Fig. 2 is a sectional view illustrating a fuel tank.

EMBODIMENTS OF THE INVENTION

A resin film, which is excellent in lubricity, corrosion-resistance and plasticity and also maintains excellent corrosion-resistance as well as adhesiveness to an anti-corrosion film even after press-working a steel sheet to a shape of a fuel tank, has been used so far as a resin film formed on an Al-coated steel sheet for use as a fuel tank. On the contrary, the inventors researched for a resin film which serves as a protective film until press-working and is easily removed from the steel substrate, without affection of such the conventional idea on the resin film. When such the resin film is realized, the resin film is completely removed from the steel sheet before seam-welding. Consequently, upper and lower halves are joined together in absence of the resin film during seam-welding, so as to avoid generation of offensive odor or smoke as decomposition products of the resin film. Even when a powdery synthetic resin which puts harmful effects on adhesiveness to an anti-corrosion film is added to the resin film serving as a protective film, durability of the fuel tank does not become worse, since the powdery synthetic resin is removed together with the resin film. However, it is very difficult to peel off a conventional resin film after the press-working, since it firmly

sticks to an Al-coated steel sheet due to drawing motion during the press-working.

The inventors investigated a conventional manufacturing process wherein halves of a fuel tank for an automobile are washed with an alkali liquid after a press-working step but before a welding step, and hit upon the idea that formation of an alkali-soluble resin film directly on a surface of an Al-coated steel sheet is profitable for removal of such a resin film by washing the halves with an alkali liquid without necessity of peeling off the resin after the press-working.

Solubility of a resin film is greatly varied in response to a pH value of an alkali liquid used for washing, as shown in Fig. 1. A time for dissolution of the resin film is changed in correspondence with the pH value. It is necessary to adjust the solubility of the resin film so that dissolution is finished within 5 minutes in an alkali liquid of pH 9.0 or higher, accounting a washing time predetermined within 5 minutes in an alkali cleaning step of a conventional process for manufacturing members of a fuel tank. Dissolution of a resin film in an alkali liquid is promoted by introduction of a free carboxyl group(s) in a molecule of the resin so as to weaken water resistance. The resin, in which a free carboxyl group(s) is introduced, has solubility varied with an acid value. The acid value is represented by a mg number of potassium hydroxide necessary for neutralization of acid contents (acid groups) in 1g a resin. If the acid value is less than 40, it takes 5 minutes or longer to completely dissolve off the resin film in an alkali liquid of pH 9.0 or higher. However, the acid value greater than 90 causes poor film-forming ability of the resin and deteriorates anti-scratching property of the resin film. In this consequence, the carboxyl group(s) is preferably introduced to the resin in the manner such that the acid value is adjusted in a range of 40-90.

In recent days, a cleaning solution is prepared at a lower and lower pH

value to keep the alkali cleaning work safe, and a cleaning time is shortened to improve productivity. In short, there has been set the work goal that the cleaning is completed within 1 minute using an alkali liquid of pH 9.0 or so. According to the work goal, the resin film shall be also dissolved off within 1
5 minute by the alkali liquid of pH 9.0. However, 3-5 minutes are ordinarily required for dissolution of a resin film, in which a free carboxyl group(s) is merely introduced so as to adjust an acid value to 40-90, in an alkali liquid of pH 9.0. Due to such a longer time for dissolution, a cleaning liquid of a higher pH value is inevitably used for shortening the cleaning time without change
10 of a resin kind. In actual, a cleaning liquid of pH 10 has been used for completion of the cleaning within 1.5-2.0 minutes, or a cleaning liquid of pH 11 or higher has been used for completion of the cleaning within 1 minute.

The inventors have searched for a method, which enables short-time cleaning using an alkali liquid of a lower pH value. In the course of searching
15 and examination, the inventors found that partial substitution of hydrogen atoms in a free carboxyl group(s) introduced to a molecule of a film-forming resin by alkali metal is effective for dissolution of a resin film within 1 minute by an alkali liquid of pH 9.0. The substitution ratio of hydrogen atoms by the alkali metal is preferably adjusted to 1-50% on the basis of all the free
20 carboxyl groups. If the substitution ratio is less than 1%, a time for dissolution of a resin film is not so shortened compared with a resin film having segregation hydroxyl groups unsubstituted by alkali metal, and the resin film is not completely dissolved off within 1 minute by an alkali liquid of pH 9.0. If the substitution ratio exceeds 50% on the contrary, a resulting
25 resin film is excessively hygroscopic so that the resin film is likely to be blocked when an Al-coated steel sheet to which the resin film is applied is stored in a coiled state.

A resin having hydrogen atoms of a free carboxyl group(s) partially

substituted by alkali metal is prepared from a resin to which a free carboxyl group(s) is introduced to adjust its acid value at 40-90. If the acid value is less than 40, dissolution of the resin film in an alkali liquid of pH 9.0 is not completed within 1 minute, regardless substitution of hydrogen atoms by
5 alkali metal. If the acid value exceeds 90 on the contrary, the resin film is poor of anti-scratching property.

An alkali-soluble resin is preferably a urethane or acrylic resin excellent in adhesiveness and plasticity, wherein a free carboxyl group(s) is introduced to adjust an acid value at 40-90, and hydrogen atoms of the free
10 carboxyl group(s) are partially substituted by alkali metal. The acrylic resin has the advantage that the free carboxyl group(s) is easily introduced, since raw material with the carboxyl group can be used for synthesis. Introduction of the free carboxyl group(s) to a urethane resin synthesized from raw materials free from carboxyl groups is performed by reaction of a hydrophilic
15 chemical compound having a carboxyl group with diisocyanate.

There are not special restrictions on synthesis of a urethane or acrylic resin. Any conventional process may be adopted, unless effects of the present invention are not hurt. However a resin form is neither restricted, a desirable resin is soluble in an organic solvent or water or dispersible in water. The
20 water-soluble or water-dispersible resin is especially desirable in the viewpoint of coating operation. A film-forming auxiliary such as an alkylene glycol derivative, dialkyl ester of an aliphatic dicarboxylic acid or N-methyl-2-pyrrolidone may be added to the resin.

The resin film is preferable of 0.2-5 μ m in thickness. If the resin film is
25 thinner than 0.2 μ m, its anti-scratching property is poor. However, the resin film thicker than 5 μ m necessitates a longer time for dissolution in an alkali cleaning step.

A powdery synthetic resin incompatible with the alkali-soluble resin

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may be added to resin composition for formation of the resin film, in the manner such that the powdery synthetic resin is partially projected from a surface of the resin film. Dispersion of such the powdery synthetic resin improves workability of the Al-coated steel sheet, so that the Al-coated steel sheet can be press-worked without application of a lubricant oil even to a part which is subjected to severe reformation. The effect of the powdery synthetic resin on workability is realized by addition at a ratio of 1 mass % or more on the basis of the resin composition. However, excessive addition of the powdery synthetic resin more than 25 mass % unstabilizes suspension of the powdery synthetic resin in a treating liquid, and causes gelation of the powdery synthetic resin. In this consequence, a ratio of the powdery synthetic resin added to the resin composition is determined within a range of 1-25 mass % (preferably 3-20 mass %).

Any of a fluororesin, a polyolefinic resin such as, polyethylene or polypropylene, a styrenic resin such as ABS or polystyrene, and a halogenized resin such as vinyl chloride or polyvinylidene chloride may be used as such the powdery synthetic resin. One or more of these powdery synthetic resins may be added to the resin composition. The powdery synthetic resin may be provided by mechanical crushing to a proper particle size or offered as a liquid suspension prepared by chemically or mechanically dispersing the synthetic resin in a proper solvent.

Addition of powdery silica to the resin composition improves heat resistance and anti-scratching property of the resin film, so that the Al-coated steel sheet can be press-worked even at a temperature of a metal die near 200 °C without damages on the resin film. The effect of the powdery silica on the anti-scratching property is realized by addition at a ratio of 1 mass % on the basis of the resin composition. However, excessive addition of silica more than 30 mass % deteriorates stability of a treating liquid. The powdery silica may

be added together with the powdery synthetic resin to the resin composition.

An Al-coated steel sheet as a substrate for formation of the resin film may be a steel sheet coated with pure Al or an Al alloy such as Al-Si (containing 3-13 mass % Si), Al-Zn, Al-Zn-Si, Al-Mg or Al-Mn. These Al-coated steel sheets are manufactured by a hot-dip process, a vacuum deposition process, a molten salt process or the like. A steel sheet coated with pure Al is preferably one manufactured by the vacuum deposition or molten salt process, since a thick Fe-Al interlayer poor of ductility is formed at a boundary between a substrate and a plating layer of a hot-dip coated steel sheet. On the other hand, since a steel sheet coated with an Al alloy can be manufactured at a low cost by the hot-dip process without formation of such a brittle interlayer, advantages of the hot-dip process are utilized.

The Al-coated steel sheet is preferably subjected to chromating treatment, after the resin film is dissolved off by alkali-cleaning. A chromate film formed on a surface of the cleaned steel substrate by the chromating treatment effectively improves corrosion-resistance of the steel substrate. Either one of reactive chromating, spray-type chromating or electrolytic chromating may be adopted for formation of such a chromate film. A phosphoric acid or inorganic sol effective for improvement of corrosion-resistance and paint adhesiveness may be optionally added to a chromating composition. The chromate film is preferably formed at a ratio of 5-100mg/m² calculated as metallic Cr. Adhesion of the chromate film at a ratio less than 5 mg/m² causes poor corrosion-resistance, but excessive adhesion of the chromate film more than 100 mg/m² abruptly deteriorates weldability.

Although there are not any special restrictions on formation of a resin film, an emulsion is prepared from a liquid resin having a carboxyl group(s) in its molecule to which a powdery synthetic resin and/or powdery silica is optionally added. Such an emulsion is applied to a steel sheet by a proper

method selected from brushing, application with rolls or bars, showering, spraying and electrostatic atomization accounting economical efficiency and productivity, to form a uniform resin film on the Al-coated steel sheet. The applied resin is dried at an ambient temperature or a high temperature.

5 After formation of the resin film, the Al-coated steel sheet is trimmed to a proper size and press-worked to a shape for upper and lower halves of a fuel tank. The halves are seam-welded or spot-welded together to a unitary body, and an anti-corrosion paint is applied to an external surface of the unitary body. Thus, a fuel tank for an automobile is manufactured. In this
10 manufacturing process, the halves are washed with an alkali liquid to dissolve off the resin film after the press-working step but before the welding step. Some fuel tanks have small sub-tanks and pipings connected thereto, in addition to the halves. The present invention is also applicable to production of such members.

15 The present invention will be more apparent from the following examples, referring to the drawings. Of course, these examples do not put any restrictions on the scope of the present invention.

Example 1

20 Several kinds of urethane emulsions containing carboxyl groups with various acid values were prepared by mixing 2,2-dimethylol propionic acid, hexamethylene diisocyanate, adipic acid, 1,4-butylene glycol and ethylene glycolic polyester polyol at various ratios. Powdery silica and/or a powdery synthetic resin (a mixture of polyethylene resin with fluororesin) were added
25 to some of the emulsions.

A steel sheet of 0.8mm in thickness hot-dip coated with an Al-9% Si alloy at a ratio of 30g/m² per single surface was used as a base sheet for painting. After the Al-coated steel sheet was chromated at a ratio of 20mg/m²

calculated as Cr, each emulsion was directly applied to the Al-coated steel sheet by a bar-type applicator, dried in an oven so as to form resin films different each other in thickness.

Table 1 shows compositions and thickness of resin films formed on
5 surfaces of the Al-coated steel sheets.

TABLE 1: COMPOSITIONS AND THICKNESS OF RESIN FILMS

Note	Example No.	An acid value of urethane	A ratio of Silica powder (mass%)	A ratio of synthetic resin powder (mass%)	Thickness (μm)
Examples of the Present Invention	1	40	5	10	1.0
	2	90	10	8	1.2
	3	75	1	12	0.8
	4	80	30	10	1.5
	5	70	15	1	2.0
	6	73	20	25	0.9
	7	80	10	8	0.2
	8	60	10	8	5.0
	9	70	—	10	1.2
	10	70	12	—	1.2
	11	75	—	—	1.0
	12	60	5	10	0.1
	13	70	5	10	7.0
	14	120	10	10	1.2
	15	60	40	10	0.9
	16	60	20	35	0.8
Comparative Examples	1	10	10	10	1.0
	2	20	10	10	1.0
	3	without a resin film (as chromated)			

Samples were cut off the Al-coated steel sheets painted with the resin films and offered to the following tests.

(1) Solubility Test of Resin Film

Each sample was immersed in a NaOH solution of pH 11 at 40°C until
5 a resin film was dissolved off. Solubility of the resin film was judged by a time period spent for dissolution of the resin film, as follows; dissolution in one minute as ◎, in 1-2 minutes as ○, in 2-5 minutes as △ and in longer than 5 minutes as ×.

(2) Anti-Scratching Test

10 A disc-shaped sample of 90mm in diameter was drawn to a cylindrical form using metal dies held at 20°C and 100°C and punches of 40mm in diameter with a drawing ratio of 2.35 and a wrinkle-pressing force of 1.5×10^4 N. The drawn sample was observed to detect persistence of the resin film at its drawn part. Anti-scratching property of the resin film was judged by a
15 residual ratio of the resin film at the drawn part as follows; a residual ratio of 80% or more as ◎, 60-80% as ○, 40-60% as △ and less than 40% as ×.

(3) Workability Test

A disc-shaped sample of 94mm in diameter L_1 was drawn to a cylindrical form using a metal die held at 100°C and a punch of 40mm in
20 diameter with a drawing ratio of 2.60 and a wrinkle-pressing force of 2.5×10^4 N. An average diameter L_2 of the drawn sample was measured, and a ratio of L_2 to L_1 was calculated. Workability of the sample was judged by the ratio L_2/L_1 as follows; a ratio less than 0.80 as ◎, 0.80-0.86 as ○, 0.86-0.90 as △ and 0.90 or more as ×.

25 (4) Corrosion Test for Inner Surface

After a sample of 84mm in diameter was drawn to a cylindrical form with a drawing ratio of 2.1 using a metal die held at 100°C, it was washed 5 minutes by spraying an alkaline liquid of pH 11 at 40°C. The washed sample

was immersed in each of test liquids A-C, and left as such 10 weeks in the test liquid which was repeatedly exchanged by new one every week. Dissolution of the resin film was measured after 10 weeks-immersion. Corrosion-resistance of the sample was judged by a dissolution loss as follows:
5 a dissolution loss less than 0.3g/m^2 (less than 0.15g/m^2 in case of the test liquid C) as \odot , $0.3\text{-}0.5\text{g/m}^2$ ($0.15\text{-}0.25\text{g/m}^2$ in case of the test liquid C) as \bigcirc and 0.5g/m^2 or more (0.25g/m^2 or more in case of the test liquid C) as \times .

10 Test Liquid A: a liquid mixture of 50% gasoline with 50% water containing 350ppm a formic acid

Test Liquid B: a liquid mixture of 85% methanol containing 350ppm a formic acid with 15% gasoline

Test Liquid C: a liquid mixture of 50% gasoline with 50% water containing 50ppm Cl^-

15 (5) Post-Coat Corrosion Test

After a sample was drawn to a cylindrical form by the same way as (4), a black aminoalkyd resin was sprayed to the sample to form a resin film of $20\mu\text{m}$ in thickness. The painted sample was examined by a salt water spraying test regulated in JIS Z2371, and a ratio of rust formation was
20 measured after 1000 hours-spraying. Post-coat corrosion-resistance of the sample was judged by the ratio of rust formation as follows: a ratio of 0% as \odot , less than 10% as \bigcirc , 10-50% as \triangle and 50% or more as \times .

Table 2 shows the test results.

TABLE 2: PROPERTIES OF AI-COATED STEEL SHEET PAINTED WITH RESIN FILMS

TABLE 2: PROPERTIES OF AL-COATED STEEL SHEET TREATED WITH WATER										
Note	Example No.	Solubility of a resin film	Anti-Scratching Property		Workability	Corrosion-resistance At Inner Surface			Post-Coat Corrosion Resistance	
			Temp. (°C) of a Metal Die	100		Test Liquid				
						A	B	C		
Examples of the Present Invention	1	○	◎	◎	◎	◎	◎	◎	◎	
	2	◎	◎	◎	◎	◎	◎	◎	◎	
	3	◎	◎	◎	◎	◎	◎	◎	◎	
	4	◎	◎	◎	◎	◎	◎	◎	◎	
	5	◎	◎	◎	◎	◎	◎	◎	◎	
	6	◎	◎	◎	◎	◎	◎	◎	◎	
	7	◎	◎	◎	◎	◎	◎	◎	◎	
	8	○	◎	◎	◎	◎	○	○	○	
	9	◎	◎	◎	◎	◎	○	○	○	
	10	◎	◎	△	△	△	△	△	△	
	11	◎	◎	△	△	△	△	△	△	
	12	◎	◎	△	△	◎	◎	△	△	
	13	△	◎	△	△	△	△	△	△	
	14	◎	◎	△	△	△	△	△	△	
	15	◎	◎	△	△	△	△	△	△	
	16	◎	◎	△	△	△	△	△	△	
Comparative Examples	1	×	◎	◎	◎	◎	◎	△	△	
	2	×	◎	◎	◎	◎	◎	△	△	
	3	—	×	×	×	×	×	×	×	

Example 2

Several acrylic resin emulsions with different acid values were prepared by reacting methyl methacrylate, buthyl acrylate, methacrylic acid and acrylic acid together at various ratios. Powdery silica and/or powdery synthetic resins (a mixture of polyethylene resin with fluororesin) were added to some of the emulsions.

A steel sheet of 0.9mm in thickness hot-dip coated with an Al-9% Si alloy at a ratio of 40g/m² per single surface was used as a base sheet for painting. After the Al-coated steel sheet was chromated at a ratio of 16mg/m² calculated as Cr, each emulsion was applied to it by a bar-type applicator and then dried in an oven to form resin films different in thickness.

Table 3 shows compositions and thickness of resin films formed on the Al-coated steel sheets, while Table 4 shows properties of the resin films measured by the same way as Example 1.

TABLE 3: COMPOSITIONS AND THICKNESS OF RESIN FILMS

Note	Example No.	An Acid Value of Acrylic Resin	A Ratio of Powderly Silica (mass%)	A Ratio of Powderly Synthetic Resin (mass%)	Thickness (μm)
Examples of the Present Invention	21	40	20	10	0.8
	22	90	15	8	1.2
	23	70	1	15	1.0
	24	70	10	1	1.0
	25	75	30	10	2.0
	26	80	10	25	1.5
	27	60	10	10	0.2
	28	85	20	9	5.0
	29	70	—	10	1.0
	30	75	20	—	1.0
	31	75	—	—	1.0
	32	80	10	10	0.1
	33	80	10	10	8.0
	34	130	10	10	1.0
	35	70	50	10	1.0
	36	78	15	40	1.0
Comparative Examples	11	10	10	10	1.2

TABLE 4: PROPERTIES OF AL-COATED STEEL SHEET PAINTED WITH RESIN FLMS

TABLE 4: PROPERTIES OF AL-COATED STEEL SHEET PAINTED WITH RESIN FILM									
NOTE	Example No	Solubility of a Resin Film	Anti-Scratching Property		Workability	Corrosion-resistance at an Inner Surface			Post-Coat Corrosion-resistance
			Temp. (°C) of a Metal Die			Test Liquid			
			20	100		A	B	C	
Examples of the Present Invention	21	○	◎	◎	◎	◎	◎	◎	◎
	22	◎	◎	◎	◎	◎	◎	◎	◎
	23	◎	◎	◎	◎	◎	◎	◎	◎
	24	◎	◎	◎	◎	◎	◎	◎	◎
	25	◎	◎	◎	◎	◎	◎	◎	◎
	26	◎	◎	◎	◎	◎	◎	◎	◎
	27	◎	◎	◎	◎	◎	◎	◎	◎
	28	◎	◎	◎	◎	◎	◎	◎	◎
	29	◎	◎	△	◎	◎	◎	◎	◎
	30	◎	◎	◎	△	◎	◎	◎	◎
	31	◎	△	△	△	△	△	△	△
	32	◎	△	△	△	◎	△	△	◎
	33	△	◎	△	△	△	△	△	◎
	34	◎	△	△	△	△	△	△	△
	35	◎	△	△	△	△	△	△	△
	36	—	—	—	—	—	—	—	—
Comparative Example	11	×	◎	◎	◎	◎	◎	△	

An emulsion of Example No. 36 was not used for application due to gelation.

Example 3

Several emulsions of carboxylic group-containing urethane resins with different acid values were prepared. After NaOH or KOH was added to each emulsion, powdery silica and/or a powdery synthetic resin (a mixture of
5 polyethylene resin with fluororesin) was added to the emulsion. The emulsion was applied to an Al-coated steel sheet by the same way as Example 1. Compositions and thickness of resin films formed on the Al-coated steel sheets are shown in Table 5.

TABLE 5: COMPOSITIONS AND THICKNESS OF RESIN FILMS

Example No.	Urethane Resin			A Ratio of Powderly Silica (mass%)	A Ratio of Powderly Synthetic Resin (mass%)	Thickness (μm)
	An Acid Value	Metal Substituted for Carboxyl Group				
		Kind	Substitution Ratio (%)			
41	40	Na	40	10	10	0.2
42	52	Na	30	1	8	2.0
43	61	Na	28	20	1	2.5
44	65	K	50	5	20	1.5
45	68	K	30	15	7	1.0
46	68	K	27	10	15	2.5
47	72	K	24	—	—	3.0
48	70	K	28	10	5	0.5
49	70	Na	18	15	3	1.0
50	76	K	20	30	10	2.0
51	76	Na	1	5	7	0.8
52	72	Na	10	—	20	1.2
53	72	Na	10	12	—	2.0
54	80	K	15	8	25	1.5
55	90	K	10	30	10	5.0
56	90	K	3	25	5	4.0
57	90	Na	0.1	15	3	2.5
58	20	K	50	10	5	2.0
59	75	K	70	15	5	1.0
60	50	—	—	10	5	1.0

A sample was cut off each Al-coated steel sheet painted with the resin film and examined by the following tests.

(6) Stability Test of an Emulsion

5 An emulsion was received in a hermetically sealed glass vessel and left as such at 40°C. Stability of the emulsion was judged by days until occurrence of thickening or gelation as follows; no detection of thickening or gelation over 20 days as ◎, over 10 days as ○ and occurrence of thickening or gelation in 10 day holding as ×.

(7) Solubility Test B of A resin Film

10 Each sample was immersed in a few kinds of NaOH solution of different pH values at 40°C, and a time period until dissolution of a resin film was counted. Stability of a resin film was judged by a time period for dissolution of the resin film as follows; dissolution in 0.5minutes or shorter as ◎, 0.5-1minute as ○, 1-3minutes as △ and longer than 3minutes as ×.

15 (8) Blocking Test

Samples were piled up in the state that resin films were held in contact together and left as such 24 hours at 40°C in an atmosphere of 90%RH with a pressure of 1200N/cm². Anti-blocking property was judged by separability of the samples as follows; spontaneous separation of the samples
20 as ◎, forcible separation of the samples without damage of resin films as ○, forcible separation of the samples with partial peeling of resin films as △ and occurrence of peeling over all the resin films due to blocking as ×.

(9) Anti-Scratching Test

25 Anti-scratching property of a resin film was judged by the same anti-scratching test as Example 1.

(10) Corrosion Test for an Inner Surface

Corrosion-resistance of a sample at its inner surface was judged by the same corrosion test as Example 1 except spraying an alkali liquid of pH 10 at

40°C for 1 minute.

(11) Post-Coat Corrosion Test

Post-coat corrosion-resistance of a sample was judged by the same post-coat corrosion test as Example 1.

5 Table 6 shows test results.

TABLE 6: PROPERTIES OF AL-COATED STEEL SHEETS PAINTED WITH RESIN FILMS

TABLE 6: PROPERTIES OF AL-COATED STEEL SHEETS FAINTED WITH RESIN FILMS												
Example No.	Stability of an Emulsion	Solubility of A Resin Film			Anti-Blocking Property	Anti-Scratching Property		Corrosion-Resistance at an Inner Surface			Post-Coat Corrosion-Resistance	
		a pH value of a NaOH Solution				Temp. (°C) of A Metal Die	Test Liquid					
		9	10	11								
41	◎	○	○	◎	○	◎	◎	◎	◎	◎	◎	
42	◎	○	○	◎	◎	◎	◎	◎	◎	◎	◎	
43	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	
44	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	
45	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	
46	○	◎	◎	◎	◎	◎	△	◎	◎	◎	△	
47	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	
48	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	
49	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	
50	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	
51	◎	○	◎	◎	◎	◎	◎	◎	◎	○	◎	
52	○	◎	◎	◎	◎	◎	△	△	◎	◎	△	
53	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	
54	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	
55	○	◎	◎	◎	◎	◎	△	◎	◎	◎	△	
56	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎	
57	◎	×	×	△	◎	◎	◎	◎	◎	◎	◎	
58	◎	×	×	×	○	◎	◎	◎	◎	◎	◎	
59	◎	×	×	◎	×	◎	◎	◎	◎	◎	◎	
60	◎	×	×	△	○	◎	◎	◎	◎	◎	◎	

Example 4

NaOH or KOH was added to emulsions (prepared in Example 2) of acrylic resins having carboxyl groups in its molecule with different acid values. Powdery silica and/or a powdery synthetic resin (a mixture of
5 polyethylene resin with fluororesin) were added to some of the emulsions.

A steel sheet of 0.9mm in thickness hot-dip coated with an Al-9%Si alloy at a ratio of 30g/m² per single surface was used as a base sheet for painting. After the Al-coated steel sheet was chromated with a ratio of 15mg/m² calculated as Cr, each emulsion was applied to the Al-coated steel
10 sheet by a bar-type applicator and dried in an oven to form resin films different in thickness on the Al-coated steel sheets.

Table 7 shows compositions and thickness of the resin films formed on the Al-coated steel sheets, while Table 8 shows properties of the painted steel sheets.

TABLE 7: COMPOSITION AND THICKNESS OF RESIN FILM

Example No.	Acrylic resin			A Ratio of Powderly Silica Powdery Silica (mass%)	A Ratio of Powderly Synthetic Resin (mass%)	Thickness (μm)
	An Acid Value	Metal for Substitution of Carboxyl Group				
		Kind	Substitution Ratio (%)			
61	40	Na	50	1	10	0.5
62	50	Na	40	10	5	0.2
63	60	K	30	—	—	0.2
64	62	K	33	7	15	2.5
65	68	K	30	15	8	1.0
66	70	K	18	10	10	2.5
67	72	K	24	—	1	0.6
68	70	K	28	15	5	0.5
69	70	Na	26	10	2	1.0
70	74	Na	20	30	10	3.0
71	74	Na	1	8	—	0.8
72	72	Na	10	8	20	2.2
73	68	Na	2	10	5	2.0
74	80	K	13	8	25	5.0
75	90	K	10	30	10	1.5
76	90	K	3	15	35	3.0
77	62	Na	0.1	10	5	2.0
78	20	K	50	10	10	2.0
79	200	—	—	—	—	2.0

TABLE 8: PROPERTIES OF AL-COATED STEEL SHEETS PAINTED WITH RESIN FILMS

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Example No.	Stability of An Emulsion	Solubility of a Resin Film			Anti-Blocking Property	Anti-Scratching Property		Corrosion-resistance at an Inner Surface			Post-Coat Corrosion-Resistance																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
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61	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

An emulsion of Example No. 76 was not uniformly applied to a steel sheet due to gelation.

Example 5

Al-coated steel sheets painted with various resin films by Examples 1-4 were drawn and pressed to shapes of upper and lower halves for a fuel tank of an automobile. Scratches were not detected on the Al plating layers after
5 being press-worked. After a plurality of openings for connection of various pipes were formed in the upper and lower halves, pipes were spot- or projection-welded to the upper and lower halves without peeling of resin films.

An alkali liquid of pH 10.5 at 40°C was sprayed to the upper and lower halves to which pipes were welded. After the upper and lower halves were
10 washed with pure water, their surfaces were observed by FT-IR analysis. It was recognized that resin films were completely dissolved off.

Thereafter, the upper half was laid on the lower half in the manner such that a flange of the upper half was held in face-to-face contact with a flange of the lower half. The flanges were seam-welded together. Any smoke
15 or offensive odor was not discharged during welding. The welded fuel tank was coated with a black paint at its whole external surface. After degraded gasoline was poured in the fuel tank, the fuel tank was left as such 1 month. Thereafter, the inner and external surfaces of the fuel tank were observed, and it was recognized that the fuel tank was held in a state free from
20 corrosion.

INDUSTRIAL APPLICABILITY

An Al-coated steel sheet for a fuel tank according to the present invention as above-mentioned has a resin film formed on its surface for
25 inhibition of scratches during press-working for shaping it to members of a fuel tank. Due to such the resin film, the fuel tank is improved in corrosion-resistance to stored fuel without exposition of base steel. Since the resin film is composed of an alkali-soluble resin, it is easily washed off by an alkali

liquid after the Al-coated steel sheet was shaped to members of the fuel tank. As a result, the Al-coated steel sheet can be welded without generation of smoke or offensive odor caused by thermal decomposition of the resin film with a weld heat.

5 Dissolution of the resin film is facilitated by proper selection of a resin which is soluble in an alkali liquid of pH 9.0 or higher. A resin having a carboxylic group(s) in its molecule to adjust its acid value within a range of 40-90 is preferable for formation of a resin film excellent in solubility and film-formability. Especially, a resin, in which 1-50% hydrogen atom of the
10 introduced carboxyl group(s) is substituted by alkali metal, is formed to a resin film which can be dissolved off in one minute by an alkali liquid of pH 9.0. A time necessary for dissolution is well balanced with anti-scratching property by adjusting thickness of the resin film to 0.2-5.0 μ m.

 The resin film, which serve as a protective layer for the Al-coated steel
15 sheet until press-working, is easily removed from the Al-coated steel sheet by alkali-washing before resistance-welding. Therefore, a powdery synthetic resin or silica may be dispersed in the resin film for improvement of anti-scratching property without harmful influences on a anti-corrosion paint layer to be formed on a surface of a fuel tank. In addition, alkali-washing is
20 performed between a press-working step and a welding step in a fuel tank-manufacturing line, so that a fuel tank is manufactured by the same line as conventional one without increase of a cost due to an additional step.

CLAIMS

1. An Al-coated steel sheet for a fuel tank having an alkali-soluble resin film directly formed on a surface of said Al-coated steel sheet.
2. The Al-coated steel sheet for a fuel tank defined in Claim 1, wherein
5 the resin is soluble in an alkali liquid of pH 9.0 or higher.
3. The Al-coated steel sheet for a fuel tank defined in Claim 1, wherein the alkali-soluble resin has a carboxyl group in its molecule with an acid value of 40-90.
4. The Al-coated steel sheet for a fuel tank defined in Claim 1, wherein
10 the alkali-soluble resin has a carboxyl group in its molecule and 1-50% hydrogen atom of said carboxyl group is substituted by alkali metal.
5. The Al-coated steel sheet for a fuel tank defined in Claim 3 or 4, wherein the alkali-soluble resin is urethane or acrylic resin.
6. The Al-coated steel sheet for a fuel tank defined in Claim 1, wherein
15 the resin film is mixed with 1-25mass% a powdery synthetic resin and/or 1-30mass% powdery silica.
7. The Al-coated steel sheet for a fuel tank defined in Claim 1, wherein the resin film of 0.2-5.0 μ m in thickness is formed on the Al-coated steel sheet.
- 20 8. A method of manufacturing a fuel tank comprising the steps of:
preparing an Al-coated steel sheet on which an alkali-soluble resin film is directly formed,
press-working said Al-coated steel sheet to upper and lower halves of a fuel tank,
25 washing said upper and lower halves with an alkali liquid to dissolve off said resin film,
welding said upper half to said lower half, and
applying a paint to an external surface of said upper and lower halves.

Country	Year	Population (millions)	Urban population (millions)	Urban population (%)	Population density (per sq km)	Population density (per sq mile)
Algeria	1980	10.0	4.0	40.0	100	260
Algeria	1985	10.5	4.5	42.9	105	272
Algeria	1990	11.0	5.0	45.5	110	284
Algeria	1995	11.5	5.5	47.8	115	297
Algeria	2000	12.0	6.0	50.0	120	310
Algeria	2005	12.5	6.5	52.0	125	323
Algeria	2010	13.0	7.0	53.8	130	336
Algeria	2015	13.5	7.5	55.6	135	349
Algeria	2020	14.0	8.0	57.1	140	362
Algeria	2025	14.5	8.5	58.6	145	375
Algeria	2030	15.0	9.0	60.0	150	388
Algeria	2035	15.5	9.5	61.3	155	401
Algeria	2040	16.0	10.0	62.5	160	414
Algeria	2045	16.5	10.5	63.6	165	427
Algeria	2050	17.0	11.0	64.7	170	440
Algeria	2055	17.5	11.5	65.7	175	453
Algeria	2060	18.0	12.0	66.7	180	466
Algeria	2065	18.5	12.5	67.6	185	479
Algeria	2070	19.0	13.0	68.4	190	492
Algeria	2075	19.5	13.5	69.2	195	505
Algeria	2080	20.0	14.0	70.0	200	518
Algeria	2085	20.5	14.5	70.7	205	531
Algeria	2090	21.0	15.0	71.4	210	544
Algeria	2095	21.5	15.5	72.1	215	557
Algeria	2100	22.0	16.0	72.7	220	570
Algeria	2105	22.5	16.5	73.3	225	583
Algeria	2110	23.0	17.0	73.9	230	596
Algeria	2115	23.5	17.5	74.5	235	609
Algeria	2120	24.0	18.0	75.0	240	622
Algeria	2125	24.5	18.5	75.5	245	635
Algeria	2130	25.0	19.0	76.0	250	648
Algeria	2135	25.5	19.5	76.5	255	661
Algeria	2140	26.0	20.0	76.9	260	674
Algeria	2145	26.5	20.5	77.4	265	687
Algeria	2150	27.0	21.0	77.8	270	700
Algeria	2155	27.5	21.5	78.2	275	713
Algeria	2160	28.0	22.0	78.6	280	726
Algeria	2165	28.5	22.5	79.0	285	739
Algeria	2170	29.0	23.0	79.3	290	752
Algeria	2175	29.5	23.5	79.7	295	765
Algeria	2180	30.0	24.0	80.0	300	778
Algeria	2185	30.5	24.5	80.3	305	791
Algeria	2190	31.0	25.0	80.6	310	804
Algeria	2195	31.5	25.5	81.0	315	817
Algeria	2200	32.0	26.0	81.3	320	830
Algeria	2205	32.5	26.5	81.6	325	843
Algeria	2210	33.0	27.0	81.8	330	856
Algeria	2215	33.5	27.5	82.1	335	869
Algeria	2220	34.0	28.0	82.4	340	882
Algeria	2225	34.5	28.5	82.6	345	895
Algeria	2230	35.0	29.0	82.9	350	908
Algeria	2235	35.5	29.5	83.1	355	921
Algeria	2240	36.0	30.0	83.3	360	934
Algeria	2245	36.5	30.5	83.6	365	947
Algeria	2250					

10

FIG.1

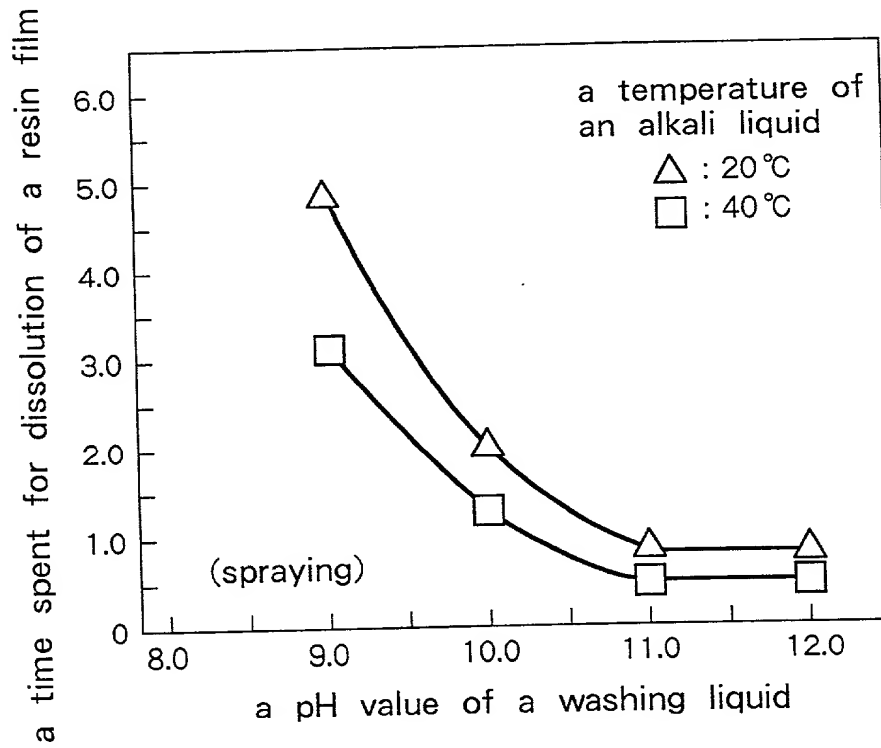
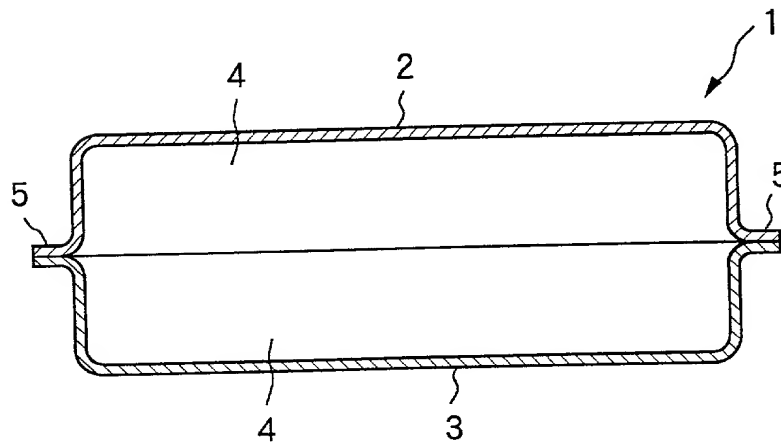


FIG.2



Declaration and Power of Attorney For Patent Application

特許出願宣言書

Japanese Language Declaration

私は、下欄に氏名を記載した発明者として、以下の通り宣言する： As a below named inventor, I hereby declare that:

私の住所、郵便の宛先及び国籍は、下欄に氏名に続いて記載した通りであり、 My residence, post office address and citizenship are as stated below next to my name.

名称の発明に関し、請求の範囲に記載した特許を求め、
る主題の本来の、最初にして唯一の発明者である（一人の氏名のみが下欄に記載されている場合）か、若しくは
本来の、最初にして共同の発明者である（複数の氏名が下欄に記載されている場合）と信じ、
I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

燃料タンク用 A 1 系めっき鋼板及びその鋼板を用いた
燃料タンクの製造方法

AN AL-COATED STEEL SHEET FOR USE AS A FUEL TANK AND A METHOD OF MANUFACTURING A FUEL TANK THEREFROM
the specification of which

その明細書を

（該当する方に印を付す）

☒ここに添付する。

☐ _____ 日に出願番号
第 _____ 号として提出し、
_____ 日に補正した。

（該当する場合）

(check one)

☒ is attached hereto

☐ was filed on _____ as
Application Serial No. _____
and was amended on _____

(if applicable)

私は、前記のとおり補正した請求の範囲を含む前記明細書の内容を検討し、理解したことを陳述する。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第 37 部第 1 章第 56 条 (a) 項に従い、本願の審査に所要の情報を開示すべき義務を有することを認める。

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a)

Japanese Language Declaration

私は、合衆国法典第35部第119条に基づく下記の外国特許出願又は発明者証出願の外国優先権利益を主張し、更に優先権の主張に係わる基礎出願の出願日前の出願日を有する外国特許出願又は発明者証出願を以下に明記する：

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

Prior foreign applications

Priority Claimed

先の外国出願			優先権の主張	
10-296570	Japan	19.10.1998	<input checked="" type="checkbox"/>	<input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(番号)	(国名)	(出願の年月日)	あり	なし
11-191477	Japan	06.07.1999	<input checked="" type="checkbox"/>	<input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(番号)	(国名)	(出願の年月日)	あり	なし

私は、合衆国法典第35部第120条に基づく下記の合衆国特許出願の利益を主張し、本願の請求の範囲各項に記載の主題が合衆国法典第35部第112条第1項に規定の態様で先の合衆国出願に開示されていない限度において、先の出願の出願日と本願の国内出願日又はPCT国際出願日の間に公表された連邦規則法典第37部第1章第56条(a)項に記載の所要の情報を開示すべき義務を有することを認める：

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)	(Filing Date)	(現況)	(Status)
(出願番号)	(出願日)	(特許済み, 係属中, 放棄済み)	(patented, pending, abandoned)

私は、ここに自己の知識に基づいて行った陳述が全て真実であり、自己の有する情報及び信ずるところに従って行った陳述が真実であると信じ、更に故意に虚偽の陳述等を行った場合、合衆国法典第18部第1001条により、罰金又は禁固に処せられるか、又はこれらの刑が併科され、またかかる故意による虚偽の陳述が本願ないし本願に対して付与せられる特許の有効性を損なうことがあることを認識して、以上の陳述を行ったことを宣言する。

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issue thereon.

Japanese Language Declaration

委任状：私は、下記発明者として、以下の代理人をここに選任し、本願の手続きを遂行すること並びにこれに関する一切の行為を特許商標庁に対して行うことを委任する。

(代理人氏名及び登録番号を明記のこと)

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